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IISC TEAM PROVIDES VIDEO EVIDENCE OF SUPERCONDUCTIVITY AT ROOM TEMPERATURE

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Superconductivity at ambient temperature has been a holy grail in physics. | Photo Credit: Peter nussbaumer - German Wikipedia

On May 24, three days after posting a revised article in *arXiv*, a pre-print repository, researchers from the Indian Institute of Science (IISc), Bengaluru, have shared a video that shows clear evidence of diamagnetism at ambient temperature and pressure. The video shows nanoparticles made of gold-silver mixture (grey/black grains) seen inside a test tube getting repelled when brought close to a permanent magnet. This is evidence of magnetic levitation. The nanomaterials were prepared in the lab.

The team led by Prof. Anshu Pandey from the institute’s Solid State and Structural Chemistry Unit, claim to have achieved superconductivity at ambient temperature and pressure.

A material is said to be a superconductor when it conducts electricity with zero resistance to the flow of electrons. Though superconductors will help build very high efficient devices leading to huge energy savings, it has not been possible to exploit it for everyday use. This is because scientists have been able to achieve superconductivity only at temperatures far below 0°C.

Superconductivity at ambient temperature has been a holy grail in physics. Hence, the IISc team, which has been able to achieve superconductivity at ambient pressure and temperature — 286 K (13°C) — will be a huge breakthrough if the work stands the test of time and other groups succeed in reproducing the results.

“At 286 K we have seen clear transition from a normal state to a superconducting state. This is more than anyone has reported,” says Prof. Arindam Ghosh from the Department of Physics at IISc and a co-author of the paper.

“New video uploaded on diamagnetism at ambient conditions in the newly claimed superconductor. First evidence of magnetic levitation and Meissner effect at room temperature? More updates soon,” Prof. Ghosh, co-author of the paper, tweeted on May 27.

Diamagnetism is one of the important properties of a superconductor. “When a magnetic field is applied from outside, then the superconductor expels magnetic field and never allows magnetic field to go through it. This is used for levitation of a superconductor,” explains Prof. Ghosh. “We were able to achieve diamagnetism at ambient temperature and pressure.”

“Some of the particles can be seen levitating due to repulsion. Levitation is seen because diamagnetism is very strong, which is expected of a superconductor,” Prof. Ghosh says.

“This [video] is definitely evidence of strong diamagnetism at room temperature. This supports the claims of superconductivity [that we have made in our paper],” he says. “But experiments are still needed to confirm other aspects of superconductivity”

“The observed diamagnetism is far stronger than the values associated with most normal materials, as well as with previous reports of nanostructured gold or silver,” they write in the paper.

Prof. Pratap Raychaudhuri from the Superconductivity Lab at the Tata Institute of Fundamental Research (TIFR), Mumbai says: “I hope it is superconductivity though this kind of diamagnetism in gold nanoparticles does not necessarily imply superconductivity.”

Prof. Ghosh agrees, and clarifies: “Gold nanoparticles can be diamagnetic, but usually that is much smaller than that of a superconductor. Superconductors are strongest diamagnets in nature. As a result, they experience maximum repelling force from a magnet. Which is probably why we can see the levitation here. There is no report of normal gold nanoparticles being levitated by a magnet.”

“For superconductivity, one has to have both diamagnetism and zero resistance. This video shows the first,” Prof. Ghosh adds.

The first version posted in *arXiv* repository on July 23, 2018 by a two-member team of Prof. Anshu Pandey and Dev Kumar Thapa attracted criticism and even questions about the study on the whole. The reason: the presence of identical pattern of noise for two presumably independent measurements of the magnetic susceptibility. Noise, by its very virtue, will be random and so finding nearly identical noise in measurements made under different conditions is highly improbable. Dr. Brian Skinner, a physicist at the Massachusetts Institute of Technology, Boston was the first to notice this.

Even the revised version still shows the repeated “noise” in some instances. In the paper, the authors have clarified the presence of “noise”.

Interestingly, the plots of magnetic susceptibility versus temperature in the new data still show the repeated “noise” patterns in some instances. In the paper, the researchers have clarified the presence of “noise” patterns: “Noise patterns occur significantly above the instrument noise threshold, and therefore suggest a possible physical origin related to the sample as opposed to instrument artefacts.”

Prof. Ghosh further clarifies: “This is the data that we got. Further studies have to be done to understand this.”

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